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13. ABSTRACT *(Maximum 200 words)*

We have built and are testing Mini-Cassegrain deformable mirrors to produce prototype bench level system in the next few weeks. These mirrors were fabricated in our clean-room facility here in Albuquerque and differ from normal DMs by having a transparent faceplate membranes and perforations in the back plate to allow light to transmit through the membrane. These minors are being tested in the clean area of our office facility. Electronics for a driver/controller are in final preparation. Parts to assemble a filly operational Mini-Cassegrain are now on-hand.

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Intellite

MICROMACHINED DEFORMABLE MIRRORS FOR BEAM CONTROL AND IMAGING APPLICATIONS

Contract Number F49620-01-C-0060
AFOSR/NE (Dr. Howard Schlossberg)
Contractor: Intellite, Inc.

Final ~~Technical Status~~ Report for 15 Nov through 14 February 2002

Task Title: Status Report 2

Objective: The objective of this task order is to develop scaleable, low-cost deformable mirrors for application to laser wavefront control and active aberration compensation for imaging and communication through the atmosphere, and for other dynamic aberrating media.

Technical Progress: This second reporting period concentrated on performance models and modeling of membrane structures and set-up and optical modeling of the Mini-Cassegrain concept.

A comprehensive deformable mirror model, DMModel™ was completed that includes faster Finite Element algorithms, improvements in the Zernike displays, ability to fit a membrane surface to user selected surfaces and far field renderings. We have also included modeling of the advanced three-level architecture mirrors. The complete model (with reduced capacity) is now posted on www.intellite.com, as well as an 18-page user's manual to assist new users.

We have built and are testing Mini-Cassegrain deformable mirrors to produce prototype bench level system in the next few weeks. These mirrors were fabricated in our clean-room facility here in Albuquerque and differ from normal DMs by having a transparent faceplate membranes and perforations in the back plate to allow light to transmit through the membrane. These mirrors are being tested in the clean area of our office facility. Electronics for a driver/controller are in final preparation. Parts to assemble a fully operational Mini-Cassegrain are now on-hand.

Technical Issues: None.

Action Items: Fabricate and test Mini-Cassegrain deformable mirrors. These mirrors will be prototypes for our first commercial product, which will incorporate fundamental solutions to packaging, handling and operations.

Schedule: The work under this Program will be conducted between October 15, 2001 and October 14, 2002. This report covers the period 15 Nov-14 Feb 2002.

Costs: Per CLIN 0001AB, $31,656.00.

Management Issues: Subcontract to Stanford has been negotiated and will be finalized during next reporting period. Intellite expects to petition for Fast Track status and

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funding and has tentatively been offered support for Phase II sponsorship and investment from an AFRL supporter. We feel we have produced a code and will soon demonstrate a mini-cass prototype that can readily be commercialized with Phase II funding.

Significant Events:

DMModel™ Software Development

Intellite's deformable mirror modeling software was designed to aid in the design of our patented micromachined deformable mirror technology, but it can be used to model virtually any continuous membrane deformable mirror. The modeling software begins by determining influence functions for a given mirror architecture. Influence functions are derived by actuating each actuator individually and storing the membrane response. The response of the mirror to voltage allows us to estimate the mechanical resonance frequency. The influence functions can be summed to determine the mirror surface shape for any configuration of voltages. The mirror surface can then be decomposed into its Zernike terms or into its own modes using single-value decomposition (SVD). Finally, Fourier transforming its electric field distribution allows us to calculate the far-field intensity profile of a beam after reflection from a deformable mirror surface.

The Screen Shot in Figure 1 shows one typical setup for a membrane as predicted by the

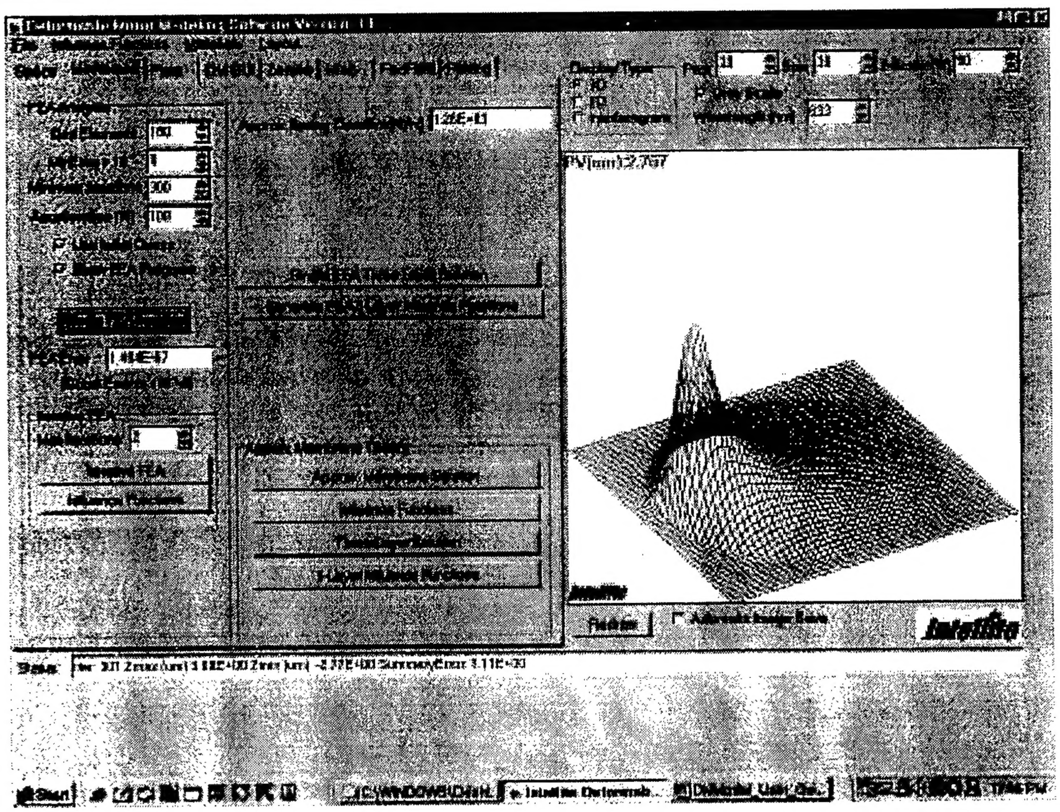

Figure 1 Membrane Tab Screen Shot from DMModel™ Code

DMModel™ code which Intellite developed under this effort.

Mini-cassegrain Hardware Development

The photograph in Figure 2 shows one architecture for the mini-cassegrain DM. The mirror membrane is inside the circular center area of the top green square piece. The gold pads are located on the back-up structure and the square pads in thee four corners are connections to external wiring. The other gold pads are soldered to the backside of the membrane and permit a fixed-offset, independent voltage to be placed onto the membrane itself.

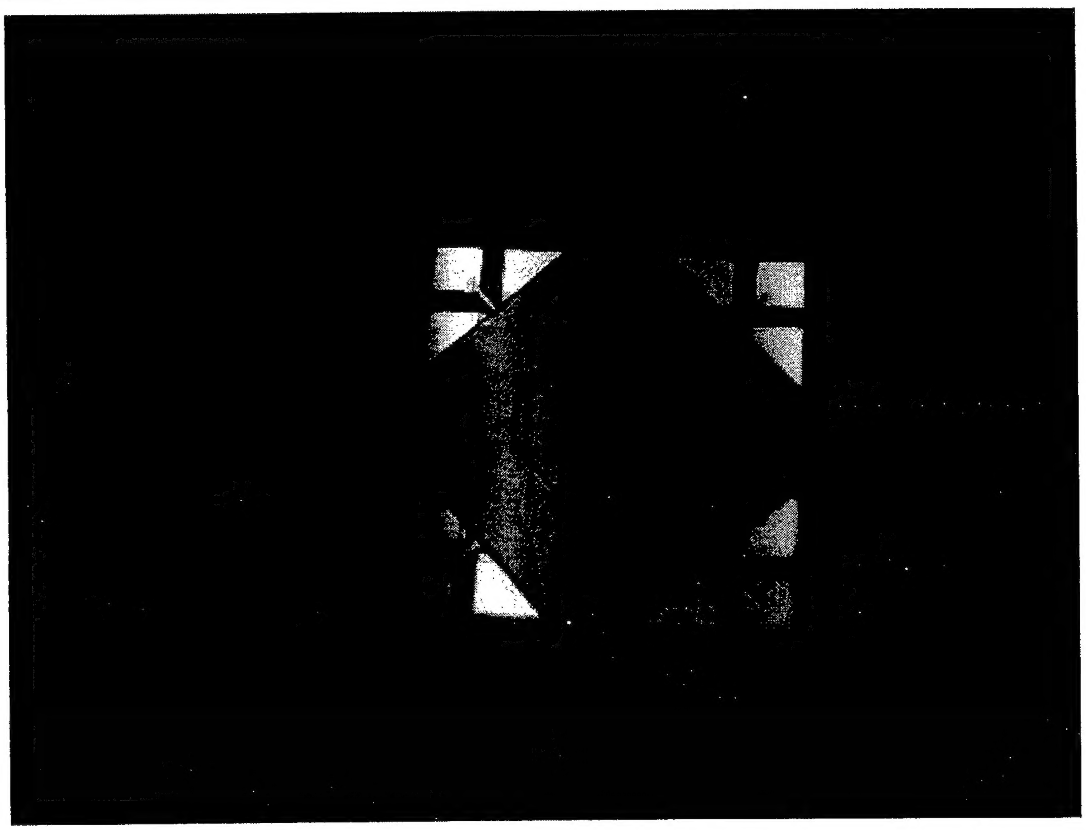

Figure 2 Mini-cass Membrane Mirror by Intellite

The small perforations in the center of the membrane allow the light to pass into the mini-cassegrain system. The central square hole is in the back plate, and the round clear hole is the clear spot in the membrane.

This mirror has four actuator pads, that permit tip/tilt and focus correction.

The mini-cassegrain architecture is diagrammed in Figure 3. In this implementation, the light source is a fiber tip that sits just behind the deformable mirror and provides a conical shaped beam into the "telescope." A secondary beam expander mirror has been

created by simply coating the central area of the primary lens, whose surfaces have been carefully designed to provide the right radius of curvature convex mirror. Once reflected from the reflective coated convex mirror surface, the light expands and reflects from the DM where additional curvature, tilt or corrections are added. Finally the expanding beam is collimated from the lens and sent toward its target some distance away. The advantage of the Mini-Cass is that it collimates and corrects the beam phase front from a common fiber source, provides a rugged and convenient structure to house the membrane DM, and is simple and inexpensive to construct. Figure Figure 4 is a photograph of one earlier mock-up of a Mini-Cass and represents a primary goal of this Phase I STTR activity: to complete and test a prototype Mini-Cass DM system ready for commercialization.

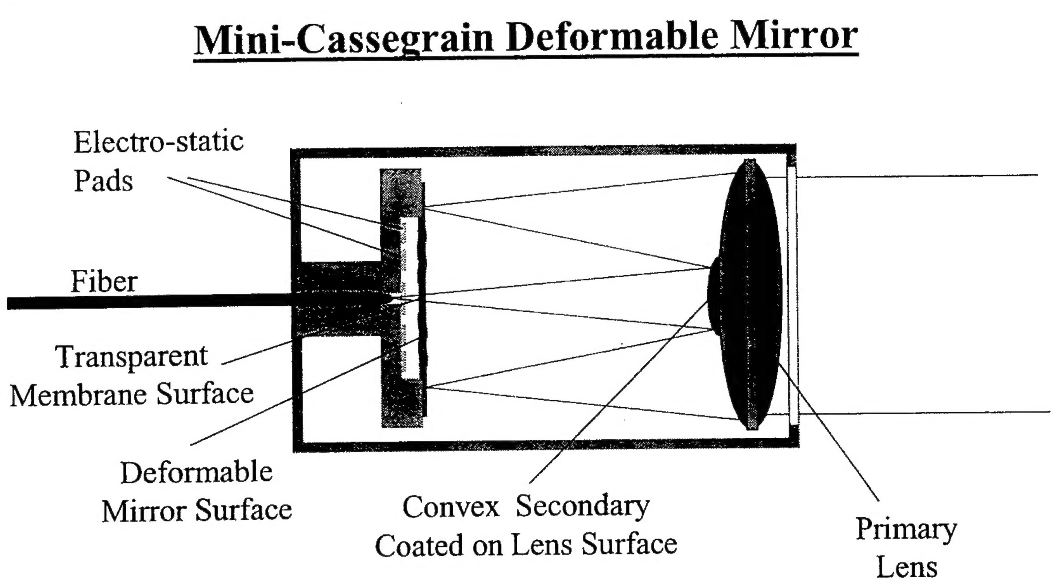

Figure 3 The Intellite Mini-Cassegrain in Cross Section

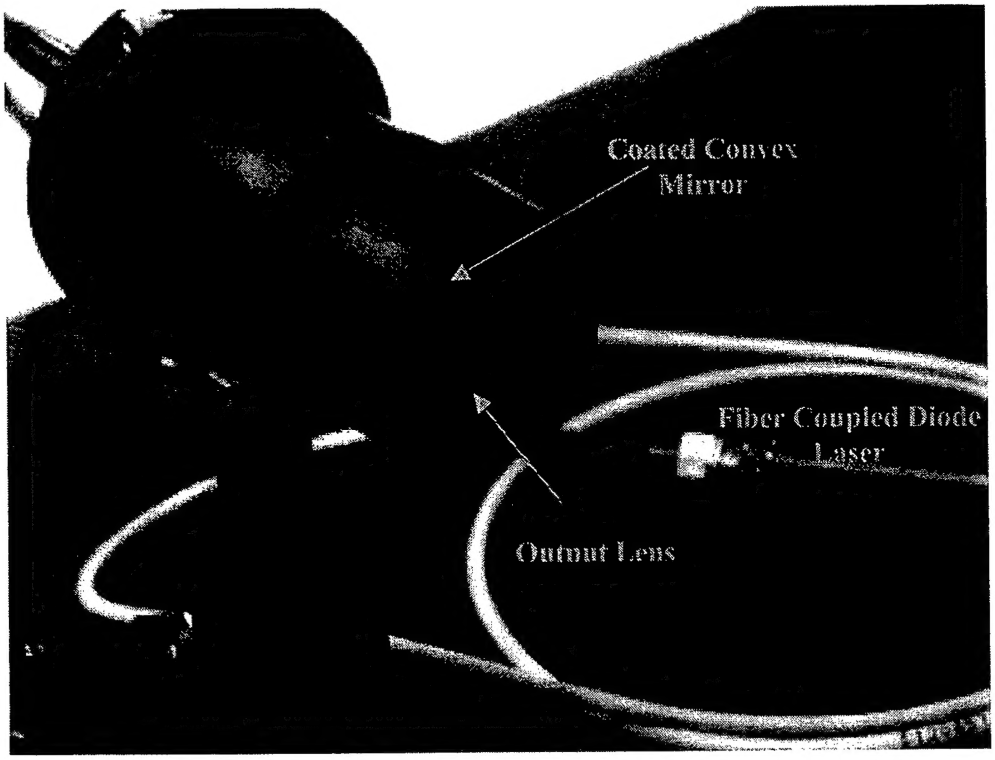

Figure 4 Photograph of Mini-Cass Prototype

AFOSR Program Manager: Dr. Howard Schlossberg/ AFOSR/NE

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